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PLAN OF WORK

for Cooperative Hydrology Investigations

Bureau of Land Management & U.S. Geological Survey -- Water Resources Division

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Preface

The Bureau of Land Management each year requires data collection and analysis and technical consulting services of its sister agency, the U.S. Geological Survey. For fiscal year 1986 services are requested of the GS's Water Resources Division.

The Plan of Work includes both Federal Coal Management Program (abbreviated CMP in summaries) and non-CMP work items. Non-CMP work items are identified by a separate BLM appropriation code included in each work item description. Agency technical contacts for the 1986 BLM/GS contract are as follows:

Bureau of Land Management

Denver Service Center
Eric B. Janes (Hydrologist), Contracting Officer's Representative, (FTS 776-0147).

U.S. Geological Survey

Water Resources Division
Donald A. Goolsby, Regional Energy Coordinator, Central Region
(FTS 776-5937)

Donald L. Coffin, Regional Program Officer, Central Region
(FTS 776-5929)

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SUMMARY OF BLM FUNDS FOR HYDROLOGIC INVESTIGATIONS
USGS WATER RESOURCES DIVISION
1986

STATE	CMP	STATE CMP	STATE 4341	O & C 6333	TOTAL
Colorado	$147,000		$49,650		$196,650
Idaho			68,590		68,590
Montana	175,000	$12,500	12,500		200,000
Nevada			6,600		6,600
New Mexico	20,000				20,000
Oregon				$30,100	30,100
Utah	184,000		41,535		225,535
Wyoming	203,000				203,000
TOTALS	$729,000	$12,500	$178,875	$30,100	$950,475

PLAN OF WORK
for
HYDROLOGIC INVESTIGATIONS
BUREAU OF LAND MANAGEMENT AND
USGS WATER RESOURCES DIVISION
Fiscal Year 1986

AUTHORITY

The General Agreement between the Bureau of Land Management (BLM) and the Geological Survey (GS), dated June 14, 1985, is considered the basis for this Plan of Work.

PURPOSE

The purpose of this Plan of Work is to specify the nature and amount of assistance to be provided by the GS to BLM during FY 86.

SCOPE

This Plan of Work includes hydrologic services to be provided by the GS to BLM in Fiscal Year 1986 in the States of Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, and Wyoming.

The GS will provide the services, including personnel, equipment, supplies, and facilities, to conduct water resources investigations in areas designated by the BLM. Services will include installation, operation, and maintenance of surface-water gages, ground-water wells, and climate stations, water-quality data collection and analysis.

PROCEDURE

Fiscal Year 1986 is the twelfth year of this cooperative effort. Some work that began in earlier Fiscal Years will be continued in Fiscal Year 1986, while some projects may be dropped. A few studies will begin in Fiscal Year 1986, some of which will carry into Fiscal Year 1987. Proposals will be discussed in joint meetings among the GS District and BLM State offices and the Denver Service Center. The Plan of Work is developed by the Denver Service Center after negotiations between BLM field offices to determine needs and GS field offices to determine capabilities, recommended hydrologic procedures, and for coordination with other studies conducted by the GS in other programs. The development of budgets takes into account the program needs of both agencies and funds available to meet those needs. When mutual interests are strong, funds from both agencies are applied. Funds tabulated in the work order, however, represent only those from BLM.

Field investigative procedures will be standard GS water resources investigation techniques.

REPORTS

Reporting will generally be standard GS report procedures with some deviations that are detailed in the Plan of Work.

Annual project progress reports will be prepared by each Water Resources Division district and routed through the Central Region to the Contracting Officer's Representative (BLM). Due date for these reports will be September 30, 1986. The GS will provide the appropriate BLM State Office with a copy of each progress report.

Prior to publishing any work involving BLM funds, the GS will forward copies of the draft final project report to the appropriate BLM State Office contact for review and approval. GS will forward two copies of the published reports to the Contracting Officer's Representative (BLM) and as many copies to the appropriate BLM State Office as agreed upon mutually between GS and BLM.

FUNDING

The BLM will provide funds to the GS to cover all authorized work listed in this Plan of Work, not to exceed $950,475 in FY 86. Billing will be through Standard Form 1081, which will be current as of the beginning of the quarter during which the interagency agreement is signed. Subsequent bills will be issued at 3-month intervals except during the last quarter when bills will be submitted at 1- to 2-month intervals. An equivalency table relating BLM projects and GS projects will be provided quarterly by the GS as will an itemized listing of costs by GS project. The GS will consider this account a reimbursable account.

COLORADO

SUMMARY OF FUNDS - FY 86
WATER RESOURCES DIVISION

Project Number	CMP	(4341)
Potential Impact of Coal Mining near Palisade, Colorado	$ 40,000	
Hydrologic Characterization of Hart Syncline Area, NW Colorado	52,000	
Foidel Creek Data Collection	15,000	
Hydrologic Data for Coal Mine Areas in NW Colorado	40,000	
Operation of BLM Stations - San Luis		$22,400
Hydrologic Investigation of Badger Creek		15,550
Streamflow Gaging Stations, Colorado Streams		11,700
	$147,000	$49,650

Total for State of Colorado: $196,650

COLORADO

Kannon Richards, BLM, State Director (FTS: 564-7500)
Rhio Jackson, BLM, Technical Investigations Coordinator (FTS: 564-7151
Steve Vandas, BLM, Hydrologic Investigations Coordination (FTS: 564-7121)
Richard O. Hawkinson, WRD, Acting District Chief, (FTS: 776-4882)

1. Potential Impact of Coal Mining near Palisade, Colorado (BLM RDTS #3440.121)

Tom Brooks, WRD Project Chief, FTS: 323-9345

A. Location:

The Rapid Creek drainage area is in Mesa County on the northwestern flank of the Grand Mesa. Rapid Creek is a perennial stream that drains directly into the Colorado River between Cameo and Palisade.

B. Objectives:

1. Compile a study bibliography
2. Describe local geology and structure (i.e., isopach maps of overburden).
3. Inventory springs, wells, streams, and reservoirs.
4. Determine relationships between hydrology and potential underground mining.
5. Report the conclusions.

C. Approach:

1. Collect all hydrologic and geologic information that would support a hydrogeologic study (i.e., mine plans).
2. Make an isopach map of overburden thickness.
3. Measure (a) about 40 spring discharges
   (b) up to 15 depths-to-water in wells
   (c) gain-and-losses on Rapid Creek and Cottonwood Creek.
4. Locate and correctly map reservoirs.
5. Field measurements will be made for pH, specific conductance, and temperature for water-quality samples.
6. Do a field investigation for evidence of fractures or subsidence and examine well logs.
7. Determine and describe ground-water flow systems in the Rapid Creek drainage.
8. Determine and describe potential hydrologic impacts from underground mining.

D. Report:

The final results and conclusions would be released as a Water Resources Investigations Report and completed by September 1986.

E. Costs:

Salaries	$32,500
Equipment and Supplies	1,000
Computer	1,500
Vehicles	5,000
TOTAL	$40,000

(BLM RDTS #3340.149)

II. Hydrologic Characterization of the hart Syncline Area, Northwestern Colorado

William Van Liew, WRD Project Chief, FTS: 776-9404

A. Location:

The study area is located southeast of Craig, Colorado. Formations of interest include the water-yielding units of the Mesaverde Group and the unconsolidated alluvial deposits along the stream channels.

B. Objectives:

To describe baseline hydrogeologic conditions in the Hart Syncline area. Specifically:

1. To determine aquifer(s) location, hydraulic properties, and water chemistry,

2. to determine surface-water discharge, chemistry, and sediment load, and

3. to determine the degree of interaction between the ground water and surface water.

C. Approach:

1. Construct monitoring wells, monitor water levels in wells monthly, conduct pumping tests, sample ground waters for chemical analysis.

2. Construct stream-gaging stations, measure streamflow monthly, sample surface waters for chemical analysis and for sediment load.

3. Compare water levels in streams with water levels in adjacent alluvial wells; compare chemical quality of surface waters with chemical quality of ground waters; sample springs for chemical analysis to compare with ground-water and surface-water chemistry.

D. Report:

A Water-Resources Investigation describing the results of the study will be prepared in FY 1987.

E. Costs:

Total project cost for FY 86 is $118,000. Funding is provided by USGS $33,000, Moffat County $33,000, and BLM $52,000. The BLM cost breakdown is as follows:

Salaries	$31,000
Travel and Vehicles	4,000
Laboratory	16,000
Equipment	1,000
TOTAL	$52,000

III. Foidel Creek Data Collection (BLM RDTS #3340.148)

Randolph S. Parker, WRD Project Chief, FTS: 776-4886

A. Location:

Routt and Moffat Counties, Colorado

B. Objective:

The objective is to maintain a gaging station in an area where hydrologic monitoring was initiated while watersheds were in a natural condition and where mining is now active or will commence soon. Data collected at this station can be used to compare the hydrologic environment in pre- and post-mining.

Data on surface-water quantity and quality and area climate will be collected. These data include continuous monitoring of discharge, water temperature, specific conductance, and two precipitation stations. Snow courses will also be maintained near the precipitation stations.

C. Report Products:

Streamflow and water-quality data will be published in the annual "Water Resources Data for Colorado."

D. Distribution of Funds:

Operation and maintenance of Foidel Creek Gage (including data storage)	$ 4,700
Water quality collection and analysis	3,300
Operation and maintenance of precipitation stations and snow courses	7,000
TOTAL	$15,000

IV. Hydrologic Data for Coal Mine Areas in NW Colorado (BLM RDTS #7210.101)

Robert Williams, WRD Project Chief, FTS: 776-9404

A. Location:

The study area is located in northwestern Colorado between Steamboat Springs and Maybell and includes coal-lease tracts north and south of the Yampa River.

B. Objectives:

1. Compile available surface water, ground water, and water quality data which are not proprietary in the study area.

2. Construct data files on the U.S. Geological Survey PRIME computer system which will be available to both the public and private sectors.

3. Establish a maintenance and updating program for computer files.

C. Approach:

The initial step in the study will involve extensive inquiries of both Federal and private groups involved with the coal mine industry to determine the availability and acceptability of existing data. The acceptability criteria will be determined at the onset of the study. The data will then be formatted into tables according to USGS standards. The data sets will be stored on a USGS PRIME computer either in existing data storage retrieval systems (such as WATSTORE) or in newly created storage systems. The data stored on the computer will be available to public and private groups. If groups requesting a tape of the data do not have a PRIME computer then, if possible, the data will be formatted to be compatible with the main frame that will be used.

Procedures to update the data sets on an annual basis will be established. This process will not include the reduction of data but strictly the input of these data into the computer file. The data to be entered in the data files will only include specific types of data arranged in a specific format.

D. Reports:

A data report will be compiled by September 1986 listing all of the data collected. The report will also describe where the data are stored and the procedure for obtaining the data.

E. Funding:

	FY 1986
Salaries	$30,000
Travel	5,000
Publication	5,000
TOTAL	$40,000

V. Operation of BLM Stations in San Luis Valley

Russell K. Livingston, WRD Project Chief, FTS: 323-9345

A. Location:

Five study sites in San Luis Valley: one reservoir site--change in contents; and four reservoir sites--inflow. Recording rain gages are operated at five sites. Twenty supplemental nonrecording raingages are also operated to provide spatial definition of precipitation.

B. Objective:

To determine effects of changes in land use on the runoff from the small drainage areas. Daily flow and rainfall will be tabulated for the four reservoir sites.

C. Report Products:

Data are published annually in "Water Resources Data for Colorado."

D. Distribution of Funds (CO-050-4341-14-2512):

Salaries	$18,900
Travel	3,500
TOTAL	$22,400

VI. Hydrologic Investigation of Badger Creek

Russell K. Livingston, WRD Project Chief, FTS: 323-9345

A. Location:

Badger Creek, tributary to Arkansas River

B. Objective:

Determine surface-water quantity and sediment yield characteristics of Badger Creek watershed at two data-collection sites. Crest stage gages will also be operated at four sites in the Badger Creek watershed to determine source areas of flood discharge.

C. Report Products:

Data are published annually in "Water Resources Data for Colorado."

D. Distribution of Funds (CO-050-4341-2512):

Salaries	$ 9,450
Travel and Vehicles	2,500
Laboratory	3,600
TOTAL	$15,550

VII. Streamflow Gaging Stations, Colorado Streams

Dannie Collins, WRD, Project Chief, FTS: 322-0302

A. Location:

The following three gaging stations will be operated to provide data necessary to define high- and low-flow characteristics of western Colorado streams:

1. 09118450--Cochetopa Creek below Rock Creek near Parlin, Colorado
2. 09123400--Lake Fork below Mill Gulch near Lake City, Colorado
3. 09060950--Big Alkali Creek below Castle Creek near Burns, Colorado

B. Objectives:

Each gaging station contains a water-stage recorder to measure stream stage which is related to discharge measurements to develop a stage-discharge relationship. Periodic current meter or indirect measurements are made to check for deviations in the stage-discharge relationship. Stream-stage record coupled with the stage-discharge relationship is used to compute the following flow characteristics: minimum daily, maximum daily, annual-peak discharge, and mean daily. These characteristics, if available for a period of above- and below-normal climatic (precipitation) conditions, can be used to describe recurrence frequencies of low- and high-flow events as well as the streams's flow-duration characteristics.

C. Report Products:

Copies of tabulated data will be provided to BLM and records will be published annually in "Water Resources Data for Colorado."

D. Distribution of Funds:

(CO-070-4341-14-2512; $4,700)
(CO-030-4341-14-2519; $7,000)

Salaries	$10,000
Travel	1,700
TOTAL	$11,700

IDAHO

SUMMARY OF FUNDS (FY 86)
WATER RESOURCES DIVISION

Project	(4341)
O & M Gaging Stations	
Birch Creek	$ 3,240
Lolo Creek	5,400
Sawmill Creek	4,320
TOTAL	$12,960
Hagerman Perched Aquifer Study	$55,630
	$68,590

Total for the State of Idaho: $68,590

IDAHO

Delmar D. Vail, BLM State Director (FTS 554-1401)
Steve Ellis, BLM Hydrologic Investigations Coordinator (FTS 554-1892)
Ernest F. Hubbard, Jr., WRD District Chief (FTS 554-1750)

I. Operation and Maintenance of Three Gaging Stations

Herman A. Ray, WRD Project Chief (FTS 554-1750)

A. Location:

1. Birch Creek
2. Lolo Creek
3. Sawmill Creek

B. Data Collection: October 1, 1985 through September 30, 1986.

C. Reports: To be published in the USGS "Water Resources Data for Idaho."

D. Funding:

One station @ $3,240 (ID-030-4341-14-25-12)	$ 3,240
One station @ $5,400 (ID-060-4341-14-25-12)	5,400
One station @ $4,320 (ID-030-4341-14-25-12)	4,320
TOTAL	$12,960

II. Hagerman landmark perched aquifer study, Hagerman, Idaho
Jerry L. Hughes, WRD Project Chief, (FTS 554-1750

A. Location: Hagerman, Idaho

B. Objectives:
1. To investigate the perched aquifer and study the influence of canal loss on the aquifer.
2. To identify best areas to place production wells.
3. To monitor the influence of production wells if they are installed.
4. To obtain data suitable to present in court in possible litigation actions.

C. Procedure: Data will be collected from 5 continuous 30-day chart recorders and 4 monthly readings from observation wells.

D. Reports: Certified data will be furnished to the BLM as it is produced and approved. Data will also be published in USGS annual data reports.

E. Distribution of Funds: (ID-010-4341-14-2513)

Drilling, 18 days @ $2,000/day	$36,000
Hydrologist on site for drilling, logging, and all attendant operations, 18 days @ $460/day	8,280
Materials and labor to fabricate 5 recorder shelters @ $150 each	750
Site inventory, 9 sites, and recorder installation of 5 sites @ $550 each	2,750
Operation and maintenance of 5 recorders	5,850
Monthly measurements at 4 additional sites @ $850 each ($3,400)/yr March - September 1986	2,000
TOTAL	$55,630

F. Timeframe: This is the first year of the project. USGS involvement will be completed in FY 1987. The BLM will continue to monitor the wells in the future until the problems have been corrected.

MONTANA

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

Project	CMP	STATE CMP	4341
I. Hydrologic Characterization			
A. Streamflow and Quality	$ 57,500		
B. Ground-Water Monitoring	35,500		
Cumulative Effects in Hanging Woman Creek Basin	82,000		
III. Estimating Flood Peaks from Channel Geometry		$12,500	$12,500
TOTAL	$175,000	$12,500	$12,000

Total for State of Montana: $200,000

Dean Stepanek, BLM Montana State Director (FTS 585-6462)
Peter Bierbach, BLM Hydrologic Investigations Coordinator (FTS 585-6655)
Joe A. Moreland, WRD, District Chief (FTS 585-5302)

I. Hydrologic Characterization of Eastern Montana Coal Areas (BLM-RDTS-7210.102/3340.502)

A. Network Maintenance of Streamflow

Ronald R. Shields, WRD Project Chief (FTS 585-5496)

1. Objectives: Collect streamflow data at key locations to supplement other programs. The data is essential in defining runoff and water quality from potential impact areas, determining streamflow characteristics, and providing a data base from which future changes can be analyzed.

2. Procedure: Standard U.S. Geological Survey methods of surface-water and water-quality data collection will be used to obtain data at the following stations:

Tongue River below Tongue River Dam-Q	Redwater River at Circle-S
Rosebud Creek at mouth near Rosebud-Q,S	Tongue River at State Line-Q
Hanging Woman Creek near Birney-S,Q	Burns Creek near Savage-S,Q
Armells Creek near Forsyth-Q	

S = Streamflow Q = Water quality

3. Report Products: Basic records from streamflow sites will be submitted to BLM annually or as mutually agreed upon. Records will be published by the USGS in an annual report, "Water Resources Data for Montana." The data will be used by the USGS in preparing interpretive reports described in other parts of the work plan.

4. Relationship to Other USGS Studies: This program will supplement and be correlated with other USGS programs of streamflow data collection. Numerous other stations are operated in this area.

5. Distribution of Funds:

Salaries	$ 34,800
Lab	5,500
Travel	10,500
Supplies	2,700
Data Processing	4,000
TOTAL	$57,500

B. Ground-Water Monitoring

Robert Davis, WRD Project Chief (FTS 585-5263)

1. Location: Fort Union and Powder River Basin coal regions of eastern Montana.

2. Objectives: To provide ground-water data base from which an assessment can be made of the resource, future responses to stresses can be predicted, and pollution and supply problems can be detected and defined. This activity provides for long-term collection of ground-water data from selected observation wells. Specifically, wells monitored in CMP study sites are incorporated in this program to extend periods of data collection. In addition, selected holes drilled by industry or other agencies are cased and tested. A five-year rotational water-quality sampling program, including about 20 sampled per year, will be initiated.

3. Procedures

   a. Make water-level measurements and continue operation of water-level recorders.
   b. Compile and analyze data.
   c. Establish ground-water quality sampling program.
   d. Collect ground water samples from about 20 selected wells.
   e. Analyze water samples.

4. Report Products: Data collected under this program will be incorporated in CMP Site Study reports and in regional evaluations. The data will be stored in automated data files for rapid retrieval.

5. Relationship to Other USGS Studies: Data collected under this activity will be used to help define premining conditions of potential lease sites, help calibrate ground water models to predict the effects of mining, and help transfer data to surrounding areas from intensively studied sites.

6. Distribution of Funds:

Salaries for Data Collection	$18,000
Laboratory Services	3,000
Travel	10,500
Data Processing	4,200
TOTAL	$35,500

II. Cumulative Effects of Coal Mining on Water Quality in Hanging Woman Creek Basin, Southeastern Montana (BLM-RDTS-7210.142)

Michael R. Cannon, WRD Project Chief (FTS 585-5263)

A. Location: The study area is in the Powder River coal region and includes part of Rosebud County.

B. Objective: The objective is to develop a dissolved-solids load budget and evaluate the potential effects of surface coal mining on dissolved solids in the stream and alluvial aquifer, both of which are used for irrigation of agricultural crops.

C. Procedures:

1. Existing surface-water flow and quality data will be supplemented by related studies.
2. Existing wells in the basin will be inventoried and sampled.
3. Observation wells will be installed where necessary. Cuttings will be obtained from the drilling.
4. Data evaluation:

   a. Develop and solve a mass-balance equation that defines all inflows and outflows of dissolved solids for the basin.

   b. Predict the quality and quantity of spoils water that would be generated by the post-mining landscape. Batch-mixing experiments will be performed using cuttings. Results will also be compared to paste-extract data from related study.

   c. Combing the additional load from the mined area to the budget equation for the undisturbed stream-aquifer system and determine the effects on dissolved-solids concentrations.

D. Report Products: The data and results will be published in the USGS Water-Resources Investigations series by September 30, 1988.

E. Relationship to Other Studies: Paste-extract data is anticipated to be obtained by a proposed concurrent study by the Montana Bureau of Mines and Geology.

F. Distribution of Funds:

	FY 86
Salaries	$47,000
Travel	4,000
Drilling	26,000
Water Analyses	3,000
Computer and Miscellaneous	1,000
Report Processing	1,000
TOTAL	$82,000

III. Revised Techniques for Estimating Flood Peaks from Channel Geometry in Eastern Montana

Charles Parrett, WRD Project Chief (FTS 585-5263)

A. Location: Eastern Montana including the Powder River and Fort Union coal regions.

B. Objectives: The objectives are to utilize data obtained over the past 5 years to revise estimating regression equations relating peak discharge to channel width at sites previously studied and to develop new equations for about 70 additional sites.

C. Procedures: Channel geometry will be measured at the new sites. Multiple-regression analysis relating channel width to peak discharge for 1,2, 4, 10, 20, and 50 percent exceedance probability will be performed for a total of about 150 sites.

D. Report Products: A report documenting the results will be published in the USGS Water-Resources Investigations series by September 30, 1986.

E. Relationship to Other Studies: The Montana Department of Highways has expressed possible cooperative interest in a similar statewide study.

F. Distribution of Funds:

	(MT-920-4121-07-2512	$12,500
	(MT-930-4341-07-2512	$12,500
Salaries		$18,450
Travel		3,550
Computer Costs		500
Report Processing		2,500
TOTAL		$25,000

NEVADA

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

	Project	4341
I.	Stream Gage Operation/Maintenance	$6,600
	TOTAL for State of Nevada:	$6,600

Edward F. Spang, BLM Director (FTS 470-5451)
Dick Jewell, BLM Hydrologic Investigations Coordinator (FTS 470-5455)
Otto Moosburner, WRD Project Chief (FTS 470-5656)

I. Operation and Maintenance of Stream Gage

A. Location

Six Mile Creek near Warm Springs, Nevada (Sta. #10246930)

B. Product Output:

1. Data from this gage will be entered into WATSTORE and published in the annual report "Water Resources Data for Nevada"

2. BLM Districts will be provided a year end station analysis.

C. Distribution of Funds:

O & M of gage	$6,600

D. Funding Code:

NV-930-4341-14-2515

NEW MEXICO

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

San Juan Coal Region

Project	CMP
Ground-Water Hydrology-San Augustine	$20,000
Total	$20,000

Total for the State of New Mexico: $20,000

Charles W. Luscher, BLM State Director (FTS 476-6217)
Chuck Pettee, Hydrologic Investigations Coordinator (FTS 476-6231)
Robert L. Knutilla, WRD District Chief (FTS 474-2246)

I. Ground-Water Hydrology of Coal Lands in San Augustine Coal Area (BLM-RDTS 3340.141)

Robert Myers, WRD, Project Chief (505) 646-1335, Las Cruces Field Office

A. Location: San Augustine Coal area located in southwestern Cibola and northwestern Catron Counties, west-central New Mexico.

B. Introduction: Coal deposits in parts of a 125 square mile tract of land in Catron and Cibola Counties, New Mexico, are being considered by the U.S. Bureau of Land Management (BLM) for coal leasing. BLM is preparing an Environmental Impact Statement (EIS) for the area and needs hydrologic information in order to address the impacts of possible coal mining on the ground-water resources in and adjacent to the area. Existing ground-water information is not adequate to address the concerns of coal activity planning. Adequate ground-water data is vital for meeting NEPA and SMCRA compliance requirements in the coal program. Such data are also required for tract delineation and site-specific analyses preceding the EIS. The San Augustine Coal Area is one of the major coal lease areas in round two of the San Juan coal leasing program. The final EIS is scheduled for completion in January, 1987.

C. Objectives: (1) To describe the ground-water hydrology of the San Augustine coal area in sufficient detail (using existing well control) for use in the coal activity planning and (2) predict the probable effects of coal mining and related activities on the following:

   a. Nearby stock and domestic wells.
   b. The quantity and quality of water in the principal aquifers (surface alluvium, Moreno Hill Formation and Dakota Sandstone).
   c. The spring flow into Zuni Salt Lake.

   This information will aid BLM in completing the second round San Juan Basin Coal EIS.

D. Approach: Impacts from mining coal in the Moreno Hill Formation are most likely to affect the quality and quantity of ground-water resources in that formation and in the Quaternary alluvium. If wells in the Dakota Sandstone are used to provide a long-term water supply for development of the coal, then some existing wells and springs that tap the Dakota may also be affected. Consequently, the proposed study will be primarily focused on identifying, measuring and selectively sampling wells in the Dakota Sandstone and younger aquifers.

Standard WRD data collection, assemblage and analytical techniques will be used. The potential effects of development on the groundwater resources of the area will be discussed. A generalized range of effects, if any, of coal lease development on spring flow at Zuni Salt Lake will be simulated analytically. To assist in this analysis, a limited number of water samples from Zuni Salt Lake, the springs, and nearby wells will be collected. These samples will be analyzed for major, minor, and trace cations The Zuni Salt Lake analysis will provide an estimate of potential effects and will be used to evaluate the need for additional data collection and interpretation in the Zuni Salt Lake area.

The amount of additional data to be collected by the U.S. Geological Survey (USGS) in the French's Arroyo area is not expected to be great because a considerable amount of information is already available. All data collected and/or utilized by the USGS will be publicly available. Aquifer structure, thickness and hydrologic head maps will be prepared and assumed stress-effect analyses will be made utilizing a range of analytical tools including non-equilibrium bounded and unbounded theory.

The study will consist of the following steps:

1. Review pertinent literature and assemble existing geohydrologic information from the files of the USGS, BLM, Salt River Project, N.M. Bureau of Mines and Mineral Resources, and N.M. State Engineer's Office.

2. Select and obtain base maps and begin preparation of aquifer geology and head maps utilizing data from one above.

3. Determine the types of additional data that can be collected within funding limits and complete field data collections. This will involve measuring of water levels, the collection of water samples for limited chemical analyses. The Salt River Project is expected to be running additional aquifer tests at test holes drilled in the French's Arroyo area.

4. Complete the geohydrologic maps and include all newly collected data and estimate development effects that are expected to impact the aquifers, wells and springs in the area.

E. Relationship to Other Studies: Existing information includes lithologic and stratigraphic data from a number of coal-test holes and 10 oil-test holes, and the potential for obtaining water-level, water quality, yield and transmissivity data from 25 stock and domestic wells. Aquifer-test data area available from two recently drilled hydrologic test wells--one in the alluvium and one in the Dakota Sandstone (Ground-water Planning Division, 1983). Previous studies deal almost exclusively with the geology of the region. No studies of the hydrology of the French's Arroyo area, other than the

aquifer tests mentioned above, have been made. Bradbury (1967, 1971) includes information on the saline water hydrology of Zuni Salt Lake. An unpublished report by San Filipo (1982) includes useful information on the geology of French's Arroyo and Zuni Salt Lake.

WRD is currently conducting ground-water studies of the Zuni Indian Reservation (NM77-225) and the Acoma and Laguna Pueblos (NM83-246, 345). A study of the general hydrology of Cibola County (NM80-230) has recently been completed by WRD. A study of Catron County (LNM81-233) was initiated in 1981 by WRD, but is progressing slowly because of funding cuts. The WRD Catron and Cibola Counties studies were programmed to provide only a general picture of the hydrology.

The Salt River Project has been test-drilling the coal deposits on State leases in the French's Arroyo area and plans to do additional hydrologic monitoring in the area. Information from the hydrologic testing program on the Salt River Project can be used by WRD in making its coal mining impact analysis. The New Mexico Bureau of Mines and Mineral Resources is also doing some geohydrologic work on State lands in Catron County. Coordination between the Bureau of Mines and USGS will be maintained.

F. Progress: In FY85, (1) selected wells throughout the San Augustine Coal Lease area were inventoried; (2) the following recorders were installed in the Zuni Salt Lake Maar: a gage on the arroyo below Smith Spring; a lake-level recorder on the cinder cone lake; a lake-level recorder on Salt Lake; and a recording rain gage; and (3) water samples were collected for analysis on selected major, minor, and trace ions from the two lakes and selected springs and wells in the Zuni Salt Lake area.

G. Report Products and Due Dates: A summary report of the geohydrology of the San Augustine coal lease area and the probable hydrologic impacts will be prepared. The first draft of the report will be available to BLM by late FY 1986, or according to the EIS time schedule, whichever is later.

H. Distribution of Funds: The study will carry through to FY 1986 for data collection and report preparation.

FY 1986 costs:	Salaries	$17,000
	Water Quality	$ 3,000
TOTAL		$20,000

OREGON

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

Project	6333
Operation and Maintenance of Stream Gages	$21,000
Sediment Sample Analysis	9,100
TOTAL	$30,100

Total for State of Oregon: $30,100

OR-011-6333-14-2519 --$ 5,250
OR-080-6333-14-2519 -- 24,850

$30,100

OREGON

William G. Leavell, BLM State Director (FTS 429-6251)
Bill Brookes, BLM Hydrologic Investigations Coordinator (FTS 429-2253)
L.B. Laird, WRD District Chief (FTS 429-2010)

I. Operation and Maintenance of Four Stream Gages

A. Location: Packers Gulch near Cascadia, Ore. (14185880);

Tucca Creek near Blaine, Ore. (14303200);

East Fork Lobster Creek near Alsea, OR (14306340)

Star Gulch near Ruch, OR (14362250)

B. Product Output:

1. Data from these gages will be entered into WATSTORE and published in the annual report "Water Resources Data for Oregon."

2. BLM Districts will be provided a primaries and a year-end station analysis for these gages.

C. Distribution of Funds:

O & M of Four gages @ $5,250	$21,000
TOTAL	$21,000

II. Sediment Sample Analysis

A. Procedure: Analysis of approximately 900 water samples for suspended sediment concentration

B. Product Output

1. Data will be entered into WATSTORE

2. Lab sheets (analytical results) will be provided to the BLM Salem District.

C. Distribution of Funds:

Salaries	$9,100
TOTAL	$9,100

UTAH

SUMMARY OF FUNDS
WATER RESOURCES DIVISION

Unita-Southwestern Utah Coal Region

	Project	4341	CMP
I.	Cooperative State Programs (UT-1, 3, and 4)	$41,535	
II.	Hydrologic Evaluation of the Castle Valley Ridge and Alkali Creek Coal-lease Areas, Utah		$ 75,000
III.	Hydrologic Evaluation of the Quitchupah, Pines, and L.C. Holding Coal-Lease Areas, Utah		109,000
	TOTALS	$41,535	184,000

Total for State of Utah: $225,535

Roland Robison, BLM State Director (FTS 588-5311)
Boyd Christensen, BLM Hydrologic Investigations Coordinator (FTS 588-3120)
Ted Arnow, WRD District Chief (FTS 588-5663)

I. Cooperative State Programs (UT-1, 3, and 4)

Russell W. Cruff, Project Chief (FTS 588-4069)

A. Objective: To determine the sediment, salinity, and discharge of selected streams in Grand, San Juan, and Uintah Counties.

B. Approach: Operate and maintain sediment, water quality, and gaging stations during FY 86.

C. Report Products: Information will be included in annual basic data report. BLM may request data directly if needed.

D. Distribution of Funds UT-932-4341-14-2519

UT-1 Collection of streamflow records.

Floy Wash	$ 4,820
Indian Creek	4,820
Cottonwood Creek near Green River	4,820
Bull Creek	4,820
Montezuma Creek (Cost shared with SCS)	2,410
SUBTOTAL	$21,690

UT-3 and 4 Collection of chemical quality, and sediment records.

Floy Wash	$ 4,410
Indian Creek	4,410
Cottonwood Creek near Green River	4,410
Bull Creek	4,410
Montezuma Creek (Cost shared with SCS)	2,205
SUBTOTAL	$19,845
TOTAL	$41,535

II. Hydrologic Evaluation of the Castle Valley Ridge and Alkali Creek Coal-lease Areas, Utah (UT-173) (BLM-RDTS-3340.143)

R.L. Seiler, Project Chief, (FTS 588-4244)

A. Location: Coal leases in the Wasatch Plateau and Book Cliffs areas in Carbon and Emery Counties, Utah.

B. Objectives: Collect those hydrologic and geologic data in and near the coal-lease areas that have been designated by BLM as priority areas in their coal-lease program. These data will enable the following pre-mining aspects of the local hydrology to be characterized:

1. Surface-water flow, variability in flow, quality, and fluvial-sediment production.

2. Geologic units and their water-bearing characteristics, and identification of geologic structure that may influence hydrology.

3. Ground-water recharge, movement, and discharge; ground-water quality; and ground water in storage.

4. Potential effects on the pre-mining hydrologic system of coal mining in and near the coal-lease areas.

Completion of these objectives will allow BLM to evaluate several water issues that were identified in past environmental impact statements as having insufficient analysis because of deficiencies in data.

C. Approach: The study will be done during the period October 1, 1984 to January 31, 1987 using the following techniques and collecting the following types of data:

1. Measure streamflow in and near the lease areas periodically and correlate flow with that for nearby gaging stations. Estimate average and peak flows using techniques and regression relations developed in the BLM/USGS program. Sample surface water for chemical analysis and periodically for sediment content.

2. Evaluate the water-bearing characteristics of geologic units and hydrologic effects of geologic structure (supplementing available geologic maps with limited field investigations). One test hole will be drilled and tested in each of the project areas if funds are sufficient, and suitable sites that could yield useful data can be located. Where possible, test holes drilled by BLM to evaluate coal resources will also be utilized to obtain hydrologic data. Tests will include determining the water level in each hole, taking a water sample, and attempting to determine hydraulic conductivity of the water-bearing material.

3. Identify sources of ground-water recharge, directions of movement, and points or areas of discharge. Make seepage runs on streams, if suitable stream reaches are available, to identify areas of ground-water recharge and discharge. Make a complete inventory of springs and wells in and near lease areas.

   Use any available ground-water head data to estimate directions of movement. Sample water from springs and wells for chemical analy- sis. Estimate saturated thickness of geologic units and the volume of ground water in storage.

4. Make qualitative estimates of the potential hydrologic effects of mining using available hydrologic and mine-plan data.

D. Progress: All relevant file data and reports were assembled and evaluated. A spring inventory was begun. Project personnel participated in BLM-funded test drilling at the Castle Valley Ridge lease and obtained water-level and geological data.

E. Reports: A final report on the lease areas will be prepared for submission to the WRD Regional Office (preliminary copy to BLM for comments) by January 31, 1987.

F. Distribution of Funds:

Salaries and benefits	$ 56,000
Travel	5,000
Vehicles	4,000
Supplies and equipment, base maps	2,000
Chemical analyses	3,000
Computer services	1,000
Report processing and printing	4,000
TOTAL	$ 75,000

III. Hydrologic Evaluation of the Quitchupah, Pines, and L.C. Holding Coal-Lease areas, Utah. (UT-176) (BLM-RDTS-3340.144)
R.L. Seiler, Project Chief, (FTS 588-4244)

A. Location: Coal leases in the Wasatch Plateau and Kolob coal fields in Sevier, Emery, and northwestern Kane Counties, Utah.

B. Objectives: Collect hydrologic and geologic data in and near the coal-lease areas that have been designated by BLM as priority areas in their coal-leasing program. These data will enable the following pre-mining aspects of the local hydrology to be characterized:

1. Average streamflow, variability in flow, quality, and fluvial-sediment production.

2. Geologic units and their water-bearing characteristics and identification of geologic structure that may influence hydrology; and, in the L.C. Holding lease, general stability of local geologic units in relation to sediment production, road construction, and mining.

3. Ground-water recharge, movement, and discharge; ground-water quality; and ground water in storage.

4. Potential effects on the pre-mining hydrologic system of coal mining in and near the coal-lease areas.

Completion of these objectives will allow BLM to evaluate several issues that have been identified in the past environmental-impact statements as having insufficient analysis because of deficiencies in data. In addition, data collected in the L.C. Holding lease area to obtain these objectives will allow better evaluation of the following local issues identified by the BLM District Office in Cedar City: (a) pre-mining and potential post-mining fluvial-sediment production in the lease area, (b) stability of geologic units during road construction and of overburden during underground coal-mining (to evaluate the potential for land subsidence), (c) potential effects on the downstream surface-water habitat of the woundfin minnow, and (d) potential effects on the hydrology of alluvial valleys and flood plains if they or underlying aquifers are disrupted by mining.

C. Approach: The study will be conducted during the period October 1, 1985 to September 30, 1987 using the following techniques and collecting the following types of data:

1. Measure streamflow in and near the lease areas periodically and correlate flow with that for nearby gaging stations. Estimate average and peak flows using techniques and regression relations developed in the BLM/USGS Program. Sample streamflow for chemical analysis and periodically for suspended-sediment content.

2. Evaluate water-bearing characteristics of geologic units and hydrologic effects of geologic structure (supplementing available geologic maps with limited field investigations). One test hole will be drilled and tested in each of the three areas if funds and suitable test locations that will produce useful data are available. Test holes drilled by BLM to evaluate coal resources will be utilized to obtain hydrologic data whenever possible. Tests will include determining the water level in each hole, taking a water sample, and attempting to determine hydraulic conductivity of the water-bearing material. In the L.C. Holding lease area, map extent of alluvial valley areas, if significant, and estimate extent of underlying alluvial aquifers. Locate any data on stability of geologic units, especially those that will be overburden during coal mining. Obtain consulting help from Geologic Division on stability of geologic units.

3. Identify sources of ground-water recharge, direction of movement, and points or areas of discharge. Make seepage runs on streams to identify areas of ground-water recharge and discharge if suitable stream reaches are available. Make a complete inventory of springs and wells in and near the lease areas. Use any available ground-water head data to estimate directions of movement. Obtain hydrologic data from nearby existing coal mines in hydrologically similar areas. Sample water from springs and wells for chemical analysis. Estimate saturated thickness of geologic units and the volume of ground water in storage.

4. Make qualitative estimates of the potential hydrologic effects of mining using available hydrologic, mine-plan, mine-production, and mining-method data.

D. Reports: A report will be prepared for submission to the WRD Regional Office (preliminary copy to BLM for comments) by September 30, 1987.

E. Distribution of Funds:

Salaries and benefits	$ 52,000
Travel	12,000
Vehicles	8,000
Supplies and Equipment, base maps	4,000
Drilling and testing test hole	26,000
Chemical analyses	5,000
Computer services	2,000
TOTAL	$109,000

WYOMING
SUMMARY OF FUNDS

WATER RESOURCES DIVISION

Project	CMP Total
I. Hydrology of Coal Spoil Piles	$43,000
II. Evaluation of the Ground-water Observation Well Program	32,000
III. Evaluating the Impacts of Coal Development on Ground-water Resources in the Powder River Basin	34,000
IV. Hydrologic Characterization of Streamflow, Water Quality, and Sediment in the Powder River Basin and Adjacent Areas	50,000
V. Fluvial System in Energy-Mineral Areas of Wyoming	44,000
TOTAL	$203,000

Total for State of Wyoming: $203,000

WYOMING

Hillary A. Oden, BLM State Director (FTS 328-2326)
Cliff Franklin, BLM Hydrologic Investigations Coordinator (FTS 328-2079)
Richard M. Bloyd, WRD District Chief (FTS 328-2153)

I. Hydrology of Coal Spoil Piles (BLM-RDTS-3340.134)

Dave Naftz, WRD Project Chief (FTS 328-2720)

A. Locations: Powder River Coal Region of Wyoming

B. Objectives: A principal concern of the hydrologic impact of coal mining in the western states is the effect of coal mining on ground-water quality. The objective of this study is to further refine understanding of geochemical reactions and to determine recharge sources to the post-mining ground waters.

C. Procedures: Samples have been collected in overburden where saturated spoil is present. Additional samples of stable isotopes in pre-mining and post-mining ground waters at the Cordero and Dave Johnston mines will be collected along with detailed water-quality samples. Isotopic ratios for carbon 13, sulfur 34, oxygen 18, and deuterium will be collected along probable flow paths (pre-mining to post-mining conditions) and used in isotopic mass balance calculations to further refine the proposed chemical reactions that might be occurring. Tritium isotopic rations will be collected in pre-mining and post-mining ground waters and surface waters to aid in assessing the source and relative amounts of recharge to the backfilled spoil materials. The pre-mining ground-water quality information will be compiled from the Department of Environmental Quality/Land Quality Division permit documents to provide a realistic data base for comparisons of pre-mining and post-mining ground-water qualities.

D. Progress. Post-mining ground-water quality data for Wyoming have been compiled and statistically analyzed from the mine permit documents. Preliminary reaction-path models have been proposed for observed changes in ground-water quality at the Cordero mine based on data collected by the USGS in cooperation with BLM. Overburden and ground-water samples collected by the USGS in 1984 within the Powder River and Hanna Basins have been analyzed and compiled in a basic data report currently in review.

E. Report Products: A report with a summary of the data collected in Fiscal Year 1984 has been prepared. An interpretive report of the data collected at the Cordero mine and of the stable isotope data is planned for Fiscal Year 1986.

F. Distribution of Funds:

Salaries	$30,000
Travel	1,000
Laboratory	12,000
TOTAL	$43,000

II. Evaluation of the Ground-Water Observation Well Program for the Powder River Basin and Adjacent Area, Northwestern Wyoming (BLM-RDTS-7210.129)

Marvin A. Crist, WRD Project Chief (FTS 328-2721)

A. Location: Powder River Coal Region of Wyoming

B. Objectives: The objective of this project is to develop a procedure to establish an observation well network in the Powder River Basin. The observation wells will be used to monitor water levels and water quality in aquifers affected by coal mining and related activities.

C. Approach: (1) Inventory the principal activities in the area that could cause stress to the ground-water system; (2) determine the needs to monitor water-level and water-quality changes that might result from each activity; (3) determine adequacy of present observation wells; (4) describe the changes needed, if any, to modify the present observation well network; and (5) determine the frequency of measurement and estimate the length of record desired.

D. Progress: Annotated outlines were prepared for the two planned reports. A work plan was prepared for the study, and work tasks were assigned. The inventory of principal activity to cause stress is complete, and work has been started on the monitoring needs.

E. Report Products: Two reports are planned. The first report, which is nearly completed, gives the procedures used to establish the observation wells. The second report, to be prepared in Fiscal Year 1986, will summarize the data obtained from the observation wells and will serve as a guide for reports published biannually that present data from observation wells statewide.

F. Distribution of Funds:

Salaries	$30,000
Travel	1,000
Equipment and Supplies	1,000
TOTAL	$32,000

III. Evaluating the Impacts of Coal Development on Ground-Water Resources in the Powder River Basin, Wyoming - A summary report of what is known, what is unknown, and how future studies can help (BLM-RDTS-7210.141)

James F. Wilson, WRD Project Chief (FTS 328-2729)

A. Location: Powder River Coal Region, Wyoming

B. Objectives: To prepare a report that:

1. Summarizes what is known about the ground-water system of the Powder River Coal Region and the impacts of coal development.

2. Identifies shortcomings in the understanding of the ground-water system.

3. Suggests ways of closing the gaps in our understanding. The suggestions should fulfill short-term needs of local, State, and Federal agencies as well as meet the long-term needs to accurately predict hydrologic effects of coal development.

C. Procedures: A topic outline will be developed to assist with the planning of the study. Authors with expertise in the various subjects will be assigned to specific sections. The final report will include sections describing the ground-water system before and after development. Each section will address geology, ground-water hydraulics, and ground-water quality. Authors will do the literature search necessary for their particular sections. It is planned that BLM hydrologists will participate in writing sections that identify where additional information is needed to assist with land-use planning and leasing activities.

D. Report Products: The intent of the project is to prepare a final report in Fiscal Year 1986. No new hydrologic data would be gathered as part of this project.

E. Distribution of Funds: Supplemental funding has been obtained from another project being conducted by the USGS in cooperation with the Wyoming Department of Environmental Quality.

Salaries	$55,000
Travel	3,000
Data processing	4,000
Report printing	2,000
TOTAL	$64,000
Supplemental funding	$30,000
BLM funding	$34,000

IV. Hydrologic Characterization of Streamflow, Water Quality, and Sediment in the Powder River Basin and Adjacent Areas, Northeastern Wyoming (BLM-RDTS-3340.129)

Stanley A Druse, WRD Project Chief, (FTS 328-2712)

A. Location: The project area is in the Powder River structural basin and adjacent area in Wyoming.

B. Objective: The objective is to help define existing surface-water conditions in the basin and monitor changes. The basin is rich in energy minerals and has huge coal reserves. The data-collection stations will be at sites where streamflow monitoring is critical to BLM, and the sites will complement an ongoing existing network of stations that are being funded by other government agencies.

C. Procedures: Standard Geological Survey methods will be used to collect streamflow, water quality, and sediment data at five stations designated by BLM.

1. Operate five continuous record streamflow stations (gage construction is required at three of the sites).

2. Collect water-quality samples at one station on 6-week intervals (10 samples per year) and have them analyzed for salinity (major constituents). Field determinations of pH, temperature, and conductivity will be made.

3. Collect suspended-sediment samples at two stations on 6-week intervals. A medium and high flow suspended sediment and bed material sample will be analyzed for particle size distribution.

D. Report Products: All collected data will be placed in computer storage (WATSTORE) on an ongoing basis and will be published in the annual data report "Water Resources Data for Wyoming." The information will continue to be used in interpretive studies related to hydrology of coal areas.

E. Distribution of Funds FY 1986:

Station Number and Name	Cost of Data Collection Activity				
	Construction	SW	CO	SED	Total
06313500 Powder River at Sussex	--	$ 6,200	--	$2,610	$ 8,810
06365300 Dry Fork Cheyenne River near Bill	3,680	6,200	--	--	9,880
06365900 Cheyenne River near Dull Ctr.	4,000	6,200	--		10,200
06426500 Belle Fourche River below Moorcroft	3,630	6,200	--	--	9,830
06643500 North Platte River near Goose Egg	--	6,200	2,470	2,610	11,280
Grand Total	$11,310	$31,000	$2,470	$5,220	$50,000

V. The Fluvial System in Energy-Mineral Areas of Wyoming (BLM-RDTS-7210.119)

Hugh W. Lowham, WRD Project Chief (FTS 328-2722)

A. Location: Powder River and Green River/Hams Fork Coal Regions of Wyoming.

B. Objectives: The objectives of the study are to describe the processes of the fluvial system for the coal areas of Wyoming and to present procedures and case histories that can be used in land-use planning to minimize erosion and provide stable drainage networks. This information can be used in land-use planning and coal leasing throughout the State to mitigate impacts of strip mining.

C. Approach: A literature search is being made to summarize knowledge applicable to channel formation and drainage development. Case histories of channel response to various past developments in Wyoming will be described to highlight the need for planning and design of stream-related projects. Channel and drainage-network data are measured with a computerized digitizer from topographic maps. Using these data, quantitative relations will be developed to aid in land-use planning and design of projects that affect runoff and channels.

D. Progress: A sample of 102 small basins in northeastern Wyoming was selected for determining physical characteristics of natural drainage networks. Twenty-two characteristics were measured for each of the basins using topographic maps and a digitizer. Graphs and relations were then developed among the characteristics found to be most important to landscape stability. Basins in other areas of Wyoming are currently being selected for addition to the data base. A progress report that describes in detail the work done so far was provided to BLM in July 1984.

E. Report Products: A final report will be prepared in Fiscal Year 1987 that summarizes these data, predictive relations, case studies, and alternative procedures that can be used for planning and designing land uses where the fluvial system is subject to alteration.

F. Distribution of Funds:

Salaries	$34,000
Travel	4,000
Computer Services	6,000
TOTAL	$44,000

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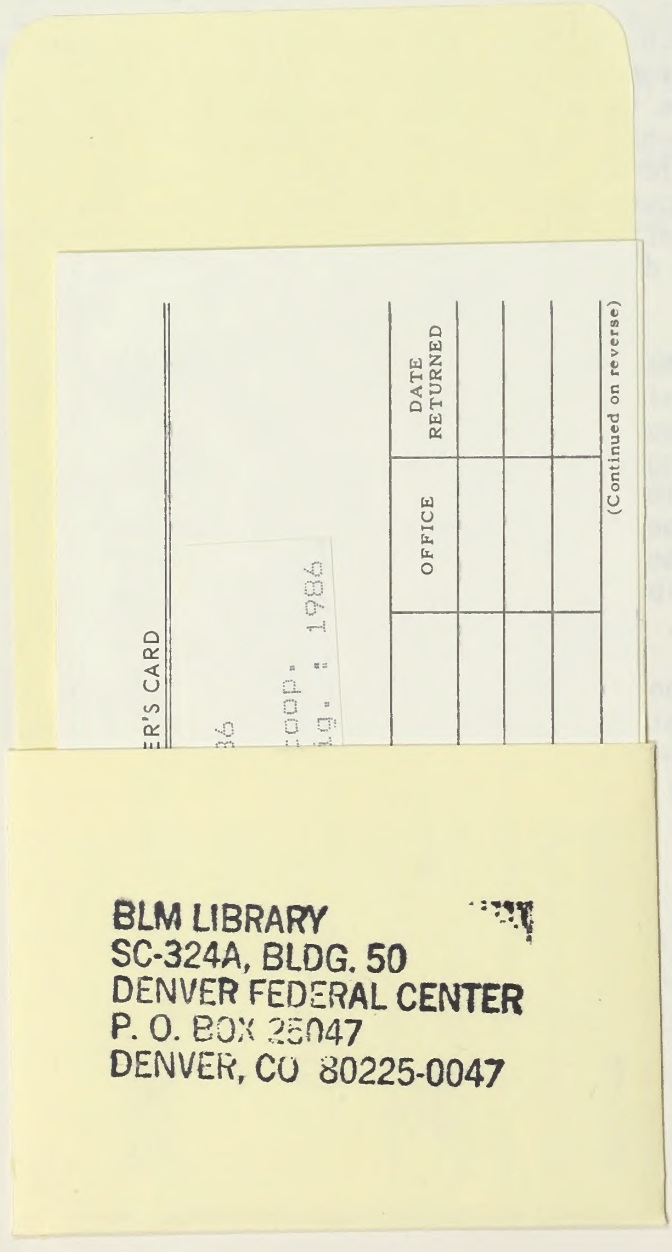
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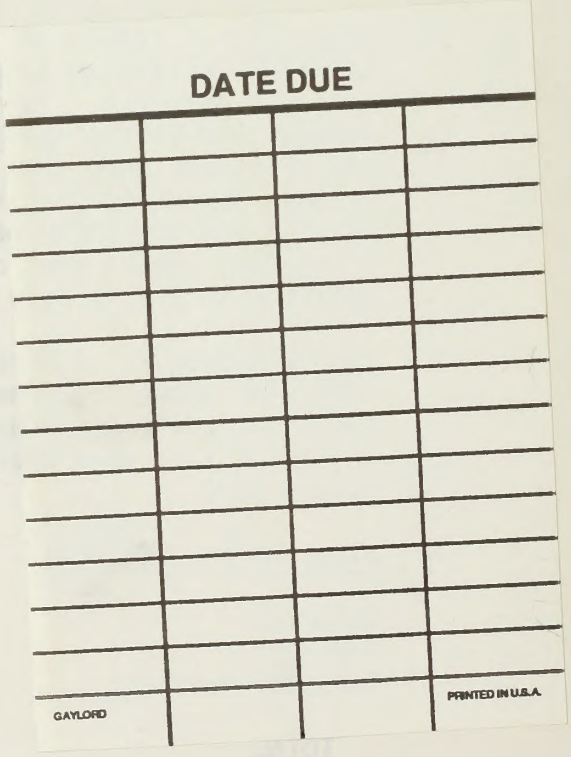
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Summary

Plan of Work

Colorado

Idaho

Montana

Nevada

New Mexico

Oregon

Utah

Wyoming